

we usually say that the forcing influence ought to be in tune with the natural frequency of the system. In every case the natural q is $\sqrt{n^2 - f^2}$, but we find the critical q to be either n or $\sqrt{n^2 - 2f^2}$.

This is probably known to mathematicians, but it is certainly not known to electrical engineers; it is a most important matter for people engaged in telephony, and especially for persons engaged in wireless signalling.

JOHN PERRY.

Inheritance of Paternal Characters in Echinoid Hybrids.

IN the Journal of the Marine Biological Association for October, 1911, we published a "Preliminary Notice on the Experimental Hybridisation of Echinoids." It comprised the results up to date of an investigation which had been carried on at the Plymouth Laboratory during 1909, 1910, and 1911. The forms experimented on were *Echinus esculentus*, *E. acutus*, and *E. miliaris*. Certain characters were studied in the hybrids, which appear in the late larvæ and do not vary in the parental forms. As the result of three years' work, we came to the conclusion that the inheritance of these characters was always strictly maternal.

The work has been repeated this year, but our results differ from those of previous years in several important points. It may, therefore, be of interest to other workers in this field if we give a brief statement of these new results at once.

The outstanding feature of this year's investigation has been the fact that *E. miliaris* eggs, when fertilised with their own sperm, have only been raised with great difficulty to a late stage. In previous years this species has always grown more healthily and developed more rapidly in the laboratory than either *E. esculentus* or *E. acutus*. This fact, we have suggested in our preliminary paper, is possibly due to *E. miliaris* being a shore form, the conditions of growth in the laboratory being more favourable to it than to the other species, which are deep-water forms. This year, however, *E. miliaris* has developed less readily under laboratory conditions than *E. esculentus*, *E. acutus*, or any of the hybrid crosses. Evidently some condition of the environment which was not present in previous years has affected the germ cells of *E. miliaris* this season.

Hybrids between *E. miliaris* ♂ and *E. esculentus* and *E. acutus* ♀ were obtained this season with ease and were, as before, strictly maternal. The crosses with *E. miliaris* ♀, on the other hand, could only be made with the greatest difficulty. Probably, then, it is the eggs and not the sperm of *E. miliaris* which are at fault. The hybrid larvæ in all the cultures of the cross *E. acutus* ♂ × *E. miliaris* ♀ turned out to be strictly paternal and not maternal, as in previous years. With one exception all the cultures of *E. esculentus* ♂ × *E. miliaris* ♀ have also been paternal with regard to the inheritance of the posterior ciliated epaulettes and the green pigment masses. The *E. miliaris* egg this year seems to be unable to transmit its characters to the hybrid offspring, as in previous years. The exception mentioned above was in the case of the only cross between *E. esculentus* ♂ and *E. miliaris* ♀, in which a large percentage of the eggs fertilised. In cultures from this fertilisation the hybrids were maternal with regard to the above-mentioned characters. Thus in the only hybrids with *E. miliaris* ♀, in which a large number of the eggs fertilised, we found the usual maternal inheritance.

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Plymouth, June 22.

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Taste or Smell in the Laughing Jackass (*Dacelo*).

WHEN experimenting on the palatability of insects, I have often noticed that birds appear to be able to tell whether an object is nice or nasty by merely holding it between the extreme horny tips of the bill. From this observation I inferred that actual contact with the tongue or soft palate was unnecessary for the purpose.

A case came under my notice to-day, however, which not only strengthened this conclusion, but suggested that some birds at all events are able to ascertain the distastefulness of some insects without actually pecking them. I offered the larva of the small Eggar moth (*Eriogaster lanestris*)—a velvety black hairy grub, ornamented with brown spots and yellow streaks—to a laughing jackass (*Dacelo cervina*). The bird was preparing apparently to take it, but when the tip of his beak was about an inch away, he drew back his head and shook it, and opened and shut his beak, exactly as I have seen birds do when tasting an unpleasant flavour. Every time the caterpillar was presented to him he behaved in the same way, and nothing would induce him to touch it. I repeated the experiment with two examples of *Dacelo leachii* and *Dacelo gigantea*, with precisely the same result.

The birds' behaviour so forcibly suggested a keen olfactory sense that, despite the distance the larva was held from their nostrils, and despite the usually accepted belief that the sense of smell is defective or absent in most birds, I do not know how to emend the keeper's remark, "They don't like the smell of it." It appeared to me, indeed, that they "smelt" the larva with the mouth, if such an expression may be used, and considering the intimate connection in ourselves between taste and smell, I think this explanation is possibly correct, although to me the larvæ individually have no appreciable scent.

A large number of the larvæ of this moth were sent to me for experiment by Mr. F. C. Woodforde, and I was able to try them with many species of birds. There is no doubt that they are, on the whole, unpalatable, but not very highly so. Some of the birds refused to touch them, others pecked them once or twice, others persevered for a long time, beating and shaking them about on the ground, generally giving them up in the end, but in one or two cases eating the mangled remains. None, however, behaved towards them as the laughing jackasses did.

Zoological Society, June 16.

R. I. Pocock.

Rearing *Asterias rubens*, L.—Larvæ with Double Hydrocoele.

THE note may be of interest that some young *Asterias rubens* have recently completed their metamorphosis here, while others are at present in the stage of sucker fixation.

The successful culture was one of several made by me in April last at the Millport Marine Biological Station, from a good supply of healthy starfish put at my disposal by the Superintendent of the station. All the cultures were taken up to Glasgow that same evening, and two days afterwards the swarming larvæ were transferred to small vessels holding about half a gallon of sea water and provided with an arrangement for securing gentle and continuous internal circulation.

In a week or so, the larvæ were fed with a culture of *Nitschia*. Two weeks afterwards a considerable number from the best jar were transferred to a second hatching vessel, and, a fortnight later, selected specimens from these were brought into a third vessel of the same type. The result was thus obtained with an expenditure of about two gallons of sea water, although a good deal more was actually employed in

connection with those other cultures which failed of success. I am indebted to one of my students, Mr. Ronald Grant, for much help in the needful manipulations.

Union of the two coelomic vesicles in front of the mouth took place about the twentieth day, while complete separation of the hydrocoele from the left posterior coelom was accomplished by the thirtieth day, all the radial pouches being unmistakable before the end of the fifth week. Fixation was observed on the fifty-second day, but it appeared afterwards that one or two specimens must have attached themselves *at least* as early as the middle of the seventh week. Now, in the ninth week, my largest specimen measures 1.75 mm. across the disc, is provided with three or four pairs of sucker feet in each ray, has well-developed eye-spots, and can travel at the rate of an inch in five to seven minutes.

Various abnormal larvæ were observed, the most remarkable being three specimens with double hydrocoele. These were perfectly symmetrical externally, and also internally, except that the left hydrocoele alone was provided with a hydropore. One of them was unfortunately lost, the second was preserved early, while the third reached a length of more than 2 mm. and entered on the stage of attachment. It then presented a remarkable appearance—the two sets of hydrocoele buds appearing as outgrowths on the surface; the arm-lobes arching round the posterior end of the body in the sagittal plane; the hydropore in the mid-dorsal line; the long processes of the ciliated band in great part absorbed; the mouth and oesophagus still open and in functional activity; the internal cavities apparently quite similar on both sides; and the whole as symmetrical as the conventional *dipleurula*, to which indeed the mode of attachment by the preoral lobe and the slanting carriage of the body gave additional resemblance.

As I watched the specimen after it became attached, the brachia, and partly also the sucker, were being used with great activity, and in such a manner that, during the thirty minutes I had it under observation, it travelled four millimetres across the bottom of its dish. When next I had the chance of looking at it, the specimen was detached and somewhat contracted, and fearing that it had suffered injury in the previous manipulation, I preserved it for future work.

It is remarkable that the twenty-five brachiolaria available for examination provided me with three examples of double hydrocoele. The culture had been made early in the season, at a time when the ovaries were distinctly unripe. It is open to suggest that these facts are directly related to one another, abnormal potencies that are ancestral in their derivation being likely to be strongest in ova hurriedly matured. Under natural conditions, double hydrocoele is apparently so rare in feeding brachiolaria that it has hitherto escaped record, although, as is well known, MacBride has directed attention to noteworthy instances of its occurrence in *Asterina*, *Ophiolithrix*, and *Echinus* (Q.J.M.S., vols. xxxviii., p. 368; li., p. 570; lvii., p. 235).

J. F. GEMMILL.

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June 19.

Clouds and Shadows.

MR. CYRIL CROSSLAND'S description (p. 322) of great shadow bands cast across the sky at sunset interested me, for I well remember being impressed by a similar phenomenon when crossing a New Mexican prairie, with the sun setting behind the Rockies. I have seen the bands in England, but imperfectly. To a non-expert, like myself, Mr. Crossland's remark, "The shadows being cast by the

reflected light of the glowing clouds in the west, not by the sun itself, of course," presents difficulties. A mass of glowing cloud seems too extensive a luminous source to cast definite shadows of peaks comparatively near it. Further, the sun being beyond the cloud, the bulk of the sunlight reflected by the cloud would fall the wrong way. Long after the sun's rays are cut off from the spectator, they will still be shining upon clouds high overhead, and therefore able to cast shadows.

If we suppose the shadow rays described to be cast by the sun itself, then it is easy to explain the appearance of the rays converging to the east, which puzzled Mr. Crossland. If the height, above the earth, of the under-surface of the cloudy stratus be roughly uniform, then this surface may be practically regarded as plane so far as it is visible to the spectator. At any rate, the curvature will be small, for the visible portion of the cloud canopy is a very small fraction of the sphere, concentric with the earth, of which it forms part. The sun being practically at infinite distance, the rays of shadow cast by it upon this overhead plane will be parallel, and hence, by the laws of perspective, will appear to converge as they recede from the zenith, or region nearest the spectator, to more distant regions east and west.

Perhaps it is not always realised how far clouds "on the horizon" may be beyond the (terrestrial) horizon. It is quite an interesting little exercise to work out. Assume the earth to be a smooth sphere, and the lower cloud surface a smooth concentric sphere. Let a line be drawn from A, the eye, to touch the earth at B, and produced to cut the cloud sphere at C. We have, roughly,

$$BC^2 = (4000 + h)^2 - 4000^2 \text{ miles,}$$

h being the height of the cloud above the earth. BC is independent of the spectator's altitude. For a cloud-height of five miles (if I have worked it right) BC is about 200 miles; and for a cloud-height of half a mile, BC is $89\frac{1}{2}$ miles.

The first volume of a great German work on meteorology was devoted to explaining why the popular impression of the form of the sky is that of a flattened vault. If this is the general impression, it has struck me that it may be based on observation of the local cloud canopy rather than of the clear sky.

ALICE EVERETT.

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POLITICS AND SCIENCE.

WE desire to call attention to two lectures delivered by Professor Karl Pearson on March 12 and 19, and now published in pamphlet form (Dulau & Co., Ltd., 1s. each). The first is entitled "Tuberculosis, Heredity and Environment," the second, "Social Problems: Their Treatment, Past, Present and Future."

The first lecture contains an account of the recent work carried out at the Galton Laboratory for National Eugenics on the subject of tuberculosis, and it is deeply to be deplored that the evidence therein contained was not made public before the Insurance Act scheme for spending vast sums of money on sanatoria was formulated. It is not too much to say that Prof. Pearson's work must revolutionise our ideas on the subject.

Briefly stated the results go to show that, at present, the influence of infection in the actual spread of the disease is small. The infection is so wide-spread that practically all the urban popu-